

actuates the actuator to maintain the [device] head assembly in the [head] position [or within the range of head positions as] indicated by the position control. As a result, a repeatable position [or range of positions] of the [brush] head assembly is obtained, the relative engagement between the head assembly and surface is controlled and the treatment of the surface by the head assembly is controlled. Position control may be used in combination with torque control of motors driving brushes for engaging the surface. Position control may also be used in combination with a pressure control measuring the pressure [between] of the [brush] head assembly [and] on the surface.

IN THE SPECIFICATION

Replace the paragraphs beginning at column 1, line 5 with the following:

This application is a continuation-in-part of prior U.S. application Ser. No. 09/177,311 which was filed on Oct. 22, 1998 (now abandoned), which is based on provisional application No. 60/062,710, filed October 22, 1997.

[The instant application is a continuation-in-part of U.S. Ser. No. 09/177,311, filed Oct. 22, 1998.]

Delete the paragraph beginning at column 2, line 48:

[In another form, the invention comprises a vehicle is adapted to ride on the surface. A head assembly adapted to carry a device engages and treats the surface. An actuator on the vehicle supports the head assembly over the surface and is adapted to raise and lower the head assembly relative to the surface. A sensor detects a position of the head assembly relative to the surface. A head position control, responsive to input from the operator, 'indicates a desired position of the head assembly relative to the surface. A driving circuit responsive to the head position control and responsive to the sensor energizes the actuator to raise and lower the head assembly so that the position of the head assembly relative to

the surface as detected by the sensor corresponds to the desired position as indicated by the head position control thereby controlling the relative engagement between the head assembly and the surface and thereby controlling the treatment of the surface by the head assembly.]

Add the following paragraph at column 2, line 48:

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A vehicle is adapted to ride on the surface. A head assembly on the vehicle is adapted to carry a device for engaging and treating the surface. A support on the vehicle is connected to the head assembly. An actuator on the vehicle is adapted to raise and lower the support. A sensor detects a position of the head assembly relative to the support. A position control, responsive to input from the operator, indicates a desired position of the head assembly relative to the support. A driving circuit responsive to the position control and responsive to the sensor energizes the actuator to raise and lower the support so that the position of the head assembly relative to the support as detected by the sensor corresponds to the desired position as indicated by the position control thereby controlling the relative engagement between the head assembly and the surface independent of the brush length or stiffness and thereby controlling the treatment of the surface by the head assembly.

Delete the paragraph beginning at column 2, line 65:

[In another form, the invention comprises a head assembly is adapted to carry a device for engaging the surface. An actuator raises and lowers the head assembly relative to the surface. A position control responsive to operator input indicates a head position of the device relative to the surface or range of head positions of the device relative to the surface. The head position or the range of head positions indicates a distance or range of distances, respectively, between the device and the

surface. A controller responsive to the position control selectively actuates the actuator to maintain the device in the head position or within the range of head positions as indicated by the position control.]

Add the following paragraph at column 2, line 65:

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A vehicle is adapted to ride on the surface. A head assembly on the vehicle is adapted to carry a device for engaging and treating the surface. A support on the vehicle is connected to the head assembly. An actuator on the vehicle is adapted to raise and lower the support. A sensor detects a position of the head assembly relative to the support. A position control, responsive to input from the operator, indicates a desired position of the head assembly relative to the support. A driving circuit responsive to the position control and responsive to the sensor energizes the actuator to raise and lower the support so that the position of the head assembly relative to the support as detected by the sensor corresponds to the desired position as indicated by the position control thereby controlling the relative engagement between the head assembly and the surface and thereby controlling the treatment of the surface by the head assembly. The sensor comprises a distance sensor connected between the support and the head assembly for detecting a distance between the support and the head assembly.

Delete the paragraph beginning at column 3, line 10:

[In yet another form, the invention comprises a head assembly adapted to carry a device for engaging the surface. An actuator raises and lowers the head assembly relative to the surface. A position control responsive to operator input indicates a repeatable head position of the device relative to the surface or a repeatable range of head positions of the device

relative to the surface. The repeatable head position or the repeatable range of head positions indicates a distance or range of distances, respectively, between the device and the surface. A controller responsive to the position control selectively actuates the actuator to maintain the device in the repeatable head position or within the repeatable range of head positions as indicated by the position control.]

Add the following paragraphs at column 3, line 10:

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A vehicle is adapted to ride on the surface. A head assembly on the vehicle is adapted to carry a device for engaging and treating the surface. A support on the vehicle is connected to the head assembly. An actuator on the vehicle is adapted to raise and lower the support. A sensor detects a position of the head assembly relative to the support. A position control, responsive to input from the operator, indicates a desired position of the head assembly relative to the support. A driving circuit responsive to the position control and responsive to the sensor energizes the actuator to raise and lower the support so that the position of the head assembly relative to the support as detected by the sensor corresponds to the desired position as indicated by the position control thereby controlling the relative engagement between the head assembly and the surface and thereby controlling the treatment of the surface by the head assembly. A compressible member of variable length is between the support and the head assembly. The sensor comprises a linear sensor detecting a length of the compressible member.

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A vehicle is adapted to ride on the surface. A head assembly on the vehicle is adapted to carry a device for engaging and treating the surface. A support on the vehicle is connected to the head assembly. An actuator on the vehicle is adapted to raise and

lower the support wherein the actuator comprises a motor rotating a screw in threaded engagement with a nut of the support. The support is raised and lowered by rotation of the screw. A sensor detects a position of the head assembly relative to the support. A position control, responsive to input from the operator, indicates a desired position of the head assembly relative to the support. A driving circuit responsive to the position control and responsive to the sensor energizes the actuator to raise and lower the support so that the position of the head assembly relative to the support as detected by the sensor corresponds to the desired position as indicated by the position control thereby controlling the relative engagement between the head assembly and the surface and thereby controlling the treatment of the surface by the head assembly. A slotted tube has a slot at one end receiving a pin sliding within the slot. The pin is connected to the nut. The tube supports the head assembly at its other end. A compressible member within the tube is between the support and the head assembly. The sensor comprises a linear sensor detecting a length of the compressible member.

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A vehicle is adapted to ride on the surface. A head assembly on the vehicle is adapted to carry a device for engaging and treating the surface. A support on the vehicle is connected to the head assembly. An actuator on the vehicle is adapted to raise and lower the support. A detector provides a count corresponding to a position of the support relative to the actuator. A position control, responsive to input from the operator, indicates a desired position of the head assembly relative to the support. A driving circuit responsive to the position control and responsive to the sensor energizes the actuator to raise and lower the support so that the position of the head assembly relative to the surface as detected by the sensor corresponds to the desired position as indicated by the position control thereby controlling the relative engagement between the head assembly and the surface

and thereby controlling the treatment of the surface by the head assembly. The actuator comprises a motor rotating a screw in threaded engagement with a nut of the support. The support is raised and lowered by rotation of the screw. The position control is set by the operator to indicate an additional preset amount the support is to be lowered below a repeatable position. A comparator compares the count to the additional preset amount. The driving circuit is responsive to comparator to lower the support below the repeatable position the additional preset amount as indicated by the position control.

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A vehicle is adapted to ride on the surface. A head assembly on the vehicle is adapted to carry a device for engaging and treating the surface. A support on the vehicle is connected to the head assembly. An actuator on the vehicle is adapted to raise and lower the support. A sensor comprising a switch on the actuator detects a position of the head assembly relative to the support. A position control, responsive to input from the operator, indicates a desired position of the head assembly relative to the support. A driving circuit responsive to the position control and responsive to the sensor energizes the actuator to raise and lower the support so that the position of the head assembly relative to the support as detected by the sensor corresponds to the desired position as indicated by the position control thereby controlling the relative engagement between the head assembly and the surface and thereby controlling the treatment of the surface by the head assembly.

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A head assembly is adapted to carry a device for engaging the surface. A support is connected to the head assembly. An actuator raises and lowers the support. A position control responsive to operator input indicates a head position of the head assembly relative to the support or range of head positions of the head assembly relative

to the support. The head position or the range of head positions indicates a distance or range of distances, respectively, between the head assembly and the support. A controller responsive to the position control selectively actuates the actuator to maintain the head assembly in the head position or within the range of head positions as indicated by the position control independent of the brush length or stiffness.

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A head assembly is adapted to carry a device for engaging the surface. A support is connected to the head assembly. An actuator raises and lowers the support. A position control responsive to operator input indicates a desired position of the head assembly relative to the support or range of desired positions of the head assembly relative to the support. The desired position or the range of desired positions indicates a distance or range of distances, respectively, between the head assembly and the support. A controller responsive to the position control selectively actuates the actuator to maintain the head assembly in the desired position or within the range of desired positions as indicated by the position control. A motor on the head assembly rotates the device. A torque control circuit having an input receives a signal for controlling the torque of the motor. A torque control responsive to operator input indicates a desired torque or a desired range of torques for the motor. The controller is responsive to the torque control for providing a torque control signal to the input of the torque control circuit to maintain the motor at the desired torque or within the desired range of torques.

In another form, the invention comprises an apparatus for use on a surface and responsive to an operator. A head assembly is adapted to carry a device for engaging the surface. A support is connected to the head assembly. An actuator raises and lowers the support. A position control responsive to operator input indicates a repeatable position of the head assembly relative to

the support or a repeatable range of positions of the head assembly relative to the support. The repeatable position or the repeatable range of positions indicates a distance or range of distances, respectively, between the head assembly and the support. A controller responsive to the position control selectively actuates the actuator to maintain the device in the repeatable position or within the repeatable range of positions as indicated by the position control independent of the brush length or stiffness.

In another form, the invention comprises an apparatus for use by an operator on a surface. A vehicle is adapted to move across the surface. A head assembly on the vehicle treats the surface. A support on the vehicle is connected to the head assembly. An actuator on the vehicle raises and lowers the support and the head assembly. A resiliently compressible member is interposed between the support and the head assembly. A sensor senses a repeatable position of the support. A control responsive to user input and the sensor controls the actuator to drive the support downward from the repeatable position an additional distance corresponding to the user input to compress the compressible member.

In another form, the invention comprises an apparatus for use by an operator on a surface. A vehicle is adapted to move across the surface. A head assembly on the vehicle treats the surface. A support on the vehicle is connected to the head assembly. An actuator on the vehicle raises and lowers the support and the head assembly. A resiliently compressible member is interposed between the support and the head assembly. A sensor senses when the head assembly is lowered to a position corresponding to contact of the head assembly with the surface, and generates a signal in response thereto. A control responsive to user input and the sensor controls the actuator to drive the support down to lower the head assembly until the signal is received and thereafter to drive the support down an additional

distance to compress the compressible member an amount corresponding to the user input.

In another form, the invention comprises an apparatus for use by an operator on a surface. A vehicle is adapted to move across the surface. A head assembly on the vehicle treats the surface. A support is connected to the head assembly. An actuator on the vehicle comprises a screw in threaded engagement with the support, and a motor rotates the screw to raise and lower the support and the head assembly connected thereto. A spring co-axial with the screw is interposed between the support and the head assembly. A control responsive to user input controls the actuator to lower the support until the head assembly is in contact with the surface and the spring is compressed a preset amount corresponding to the user input.

Replace the paragraph beginning at column 4, line 8 with the following:

A linear potentiometer 48 is positioned between the nut 38 and the head assembly 46 and generates a voltage signal via line 50 which indicates the distance between the nut 38 and head assembly 46. This generated signal also indicates changes in the length of the compressible member 40. A driving circuit 52 selectively energizes the motor 34 to drive the screw 36. When the screw is driven in one direction (e.g., counterclockwise), the nut 38 moves upward away from the floor 32 thereby pulling the spring 40 and the head assembly 46 upward away from the floor 32. When the screw 36 is driven in the opposite direction (e.g., clockwise), the nut 38 is driven downward toward the floor 32 causing the spring 40 and head assembly 46 to also move downward. This movement continues until the head assembly 46 contacts the floor 32 at which point the compressible member 40 and linear potentiometer 48 begin to compress. An operator adjusts a [head] position potentiometer 51 on a control panel which indicates a desired position of the head assembly relative to the nut and which approximately indicates the desired position of the head

assembly 46 relative to the floor 32. A comparator 54 compares the voltage signal provided via line 50 indicating the length of the linear potentiometer 48 to the voltage signal generated by the [head] position potentiometer 51. The voltage signals may be scaled to accommodate this comparison. When these signals correspond to each other indicating that the position of the head assembly 46 as indicated by the linear potentiometer 48 corresponds to the desired position of the head assembly 46 as indicated by the position of the [head] position potentiometer 51, the comparator 54 signals the driving circuit 52 and further energization of the motor 34 is discontinued.

Replace the paragraph beginning at column 5, line 28 with the following:

As the nut 69 moves upward and downward, the spring 68 is expanded or compressed causing the linear potentiometer 74 to expand or contract and to measure the distance between the nut and head assembly (i.e., the change in spring length). Referring again to FIG. 1, the voltage signal 50 generated by the linear potentiometer 48 (74 in FIG. 2) is provided to a comparator 54 and this voltage signal is compared to a voltage signal generated by the [head] position potentiometer 51. The comparator 54 provides a signal to the driving circuit 52 which signal is a function of the comparison between the linear potentiometer voltage signal 50 and the [head] position potentiometer voltage signal. When these signals correspond to each other, the driving circuit discontinues operation of the motor 34.

Replace the paragraph beginning at column 5, line 41 with the following:

For example, in FIG. 1 assume that the voltage signal of the linear potentiometer varies from 15 v to 5 v as the spring is compressed. Also, assume that the voltage signal of the head position potentiometer 51 varies from 15 v to zero, with zero

volts corresponding to the down-most portion of the head assembly 46. If the signal from the [head] position potentiometer 51 is correspondingly larger than the signal 50 of the linear potentiometer 48, the driving circuit 52 energizes motor 34 to move the nut 38 upward to expand the linear potentiometer [74] 48 so that the signal from the linear potentiometer 48 increases until it corresponds to the signal from the [head] position potentiometer 51. Similarly, if the linear potentiometer voltage signal 50 is correspondingly less than the [head] position potentiometer 51 voltage signal, the comparator 54 provides a signal to the driving circuit 52 which causes the driving circuit 52 to drive the motor 34 in such a manner to cause the nut 38 to move downward and compress the linear potentiometer 48 until the signals correspond. Preferably, the comparator 54 and driving circuit 52 are configured so that the actuator 39 will not activate unless there is a difference between the linear potentiometer signal 50 and the head position potentiometer 51 of at least a certain amount, such as 0.06 volts. In other words, the actuator 39 is not energized if the linear potentiometer signal 50 and the [head] position potentiometer 51 signal fall within a defined range or window of operation. Sensors, such as upper limit switch 58 and a lower limit switch (not shown), control the maximum up and the maximum down positions. For example, such limit switches on the actuator 39 may sense the maximum positions.

Replace the paragraph beginning at column 6, line 36 with the following:

To lower the brush head assembly 61, switch 56 is placed in the "down" position. The linear actuator 39 as controlled by the driving circuit 52 drives the nut 69 downward thereby lowering the brush head 61. The nut 69 will continue to move downward until the brushes 63 touch the floor. At this point, the nut 69 begins to compress the spring 68 and the actuator pin 71 in the end of the nut 69 begins to move downward within the slots 70 of

the tube 65. As the actuator pin 71 moves downward, it will compress the linear potentiometer 74. The nut 69 will continue to move downward until the voltage signal of the linear potentiometer 74 reaches the corresponding voltage potential (or scaled value) of the [head] position potentiometer 51 set by the operator on the control panel.

Replace the paragraph beginning at column 6, line 63 with the following:

When the brush encounters an elevation change in the floor, the linear actuator 39 as controlled by the driving circuit 52 drives the nut 69 upward thereby raising the brush head 61. The nut 69 will expand the spring 68 and the actuator pin 71 will move upward in the slots 70 of the tube 65. As the actuator pin 71 continues to move upward in the slots 70, it expands the length of the linear potentiometer 74. The nut 69 will continue to move upward until the voltage signal of the linear potentiometer 74 reaches the corresponding voltage potential (or scaled value) of the [head] position potentiometer 51 set by the operator on the control panel.

Replace the paragraph beginning at column 7, line 7 with the following:

The driving circuit 52 and comparator 54 (FIG. 1) constitute a motor controller which compares the voltages of the linear potentiometer 48 with the [head] position potentiometer 51. There is a minimum and maximum voltage setting programmed into the controller. The controller will tell the actuator 39 to stop if the linear potentiometer 48 reaches one of these settings. Pressing the "up" position on switch 56 will override these settings thus allowing the actuator 39 to raise the brush head assembly 46 off the floor 32. The controller is configured to have a voltage window setting that compares the voltages (or scaled value) of the linear potentiometer 48 to the [head] position potentiometer 51. The window is set such that small

variations or movements of the linear potentiometer 48 will not cause the actuator 39 to move. This is to prevent constant adjustment of the actuator 39. It is also contemplated that the comparator and driving circuit 52 constituting the motor control may be implemented digitally. For example, the linear potentiometer signal 50 and the voltage signal of head position potentiometer 51 may be digitalized by an A/D converter and the resulting digital signals compared by a digital processor which controls the actuator 39.

Replace the paragraph beginning at column 7, line 29 with the following:

To change the brush force, the [head] position potentiometer 51 is turned either to a higher or lower setting. The controller will then cause the motor 34 to activate to extend or retract the nut 38 until the linear potentiometer 48 reaches the corresponding voltage potential of the [head] position potentiometer. The brush head assembly 61 can be raised at any time by pressing the "up" position of the rocker switch to raise the brush head off the floor. Pressing the down position of the switch will cause the brush head to lower. It will continue to lower until the linear potentiometer reaches its corresponding set position.

Replace the paragraph beginning at column 7, line 40 with the following:

The automatic brush head positioning system according to the invention and as illustrated in FIGS. 1 and 2 detects the floor position by monitoring the movement of the actuator pin 71 on the nut 69. When the brush head assembly 46 is in the "up" position (brush 63 is off the floor 32) the actuator pin 71 contacts and engages the top portion of the slots 70. When the brush head 61 is lowered and the brushes 63 contact the floor 32, the pin 71 will begin to move downward within the slots 70. By monitoring the [relative] position of the actuator pin 71 relative to the

tube assembly 65, the head positioning system can detect the position of the floor 32 relative to the machine 100. If the brush 63 wears or a different type of brush is used, the same brush position can be attained without having to change the [head] position potentiometer 51 settings. The brush [head] assembly 46 will always return to the [relative] same position of the actuator pin 71 relative to the tube 65 independent of the actual brush height. Also, as noted above, the head assembly 46 will adjust to various floor surface contours using the same concept.

Replace the paragraph beginning at column 7, line 59 with the following:

FIG. 3 is a block diagram of one preferred embodiment of a system 1 according to the invention. The system 1 includes a brush up/down switch 2 which is controlled by an operator to raise and lower a lower head assembly 4 relative to an upper head assembly 5 affixed to a vehicle. The lower head assembly 4 includes a brush 6 for engaging and treating a floor surface 8. When the operator actuates or closes switch 2, this indicates to the driving circuit 10 that a drive motor 12 may be energized to raise or lower the head assembly 4. For example, switch 2 would be close circuited to indicate that the head assembly 4 should be lowered and switch 2 would be open circuited to indicate that the head assembly 4 should be raised. Initially, an operator would set a [head] position control 18 to indicate a desired position for the lower head assembly 4. For example, control 18 may be a potentiometer associated with a scale, display, index or other indicator indicating the desired position of the lower head assembly 4 relative to the nut 69. The indicator may indicate inches of downward movement, inches from the floor or a percentage of either, or some other indicator of position. The motor 12 drives the head assembly 4 up or down, such as by rotating a screw, and includes a position sensor 13 which indicates the position of the head assembly 4 relative to the nut

69. For example, the motor 12 may be a Warner Actuator E150 position system. It includes an actuator internal position potentiometer which indicates the position of a screw which it drives. When switch 2 is closed by the operator to indicate that the head assembly 4 should be lowered, driving circuit 10 continuously energizes motor 12 to lower the head assembly 4 until the [head assembly 4] nut 69 reaches a position corresponding to the position of the [head] position control 18. A comparator 24 or op-amp compares the signal provided by the position sensor 13 to a signal provided by the [head] position control 18. When these signals are nulled out or approximately equal, comparator 24 will provide a signal to the driving circuit 10 to discontinue energizing the motor 12. The driving circuit 10 will drive the [head assembly 4] nut 69 up or down depending on which signal has a greater value. The comparator controls the driving circuit 10 to cause the motor 12 to rotate the screw driving the head assembly 4 clockwise or counter clockwise to raise or lower the [head assembly 4] nut 69 until its position matches the desired position as indicated by the control 18. If the operator sets control 18 to its maximum down position, the driving circuit 10 will drive the [head assembly 4] nut 69 to its fully extended position. If switch 2 is placed in the "up" position, the driving circuit 10 will drive the [head assembly 4] nut 69 to its fully retracted position. As shown in FIG. 3, an optional input from the position sensor 13 to the driving circuit 10 indicates the position of the [head assembly 4] nut 69 to the driving circuit 10. This optional input is particularly useful in digital systems.

Replace the paragraph beginning at column 8, line 42 with the following:

In one respect, the system 1 of FIG. 3 is a position follower system. An actuator 39 (motor 12 plus driving screw) downwardly extends and upwardly retracts the head assembly 4 in

response to an operator's command as indicated by [head] position control 18. As the operator turns control 18, the reversible motor 12 turns the screw driving the head assembly 4 until the position sensor 13 matches the setting of control 18. One way to accomplish this position follower system is to have identical potentiometers for position sensor 13 and control 18 feeding the inputs of an op-amp which functions as the comparator 24. If the inputs to the op-amp are the same, the driving circuit 10 does not energize the motor 12. If the inputs are different, the motor 12 will rotate in the appropriate direction until the inputs are equal. If full "up" is indicated, the motor is operated to raise the head assembly 4 until the position sensor 13 indicates a value corresponding to the fully retracted position.

Replace the paragraph beginning at column 8, line 59 with the following:

FIG. 4 is a block diagram of another preferred embodiment of a system 100 according to the invention. The system 100 includes a brush up/down switch 102 which is controlled by an operator to raise and lower a lower head assembly 104 relative to an upper head assembly 105. The head assembly 104 includes a brush 106 for engaging and treating a floor surface 108. When the operator actuates or closes switch 102, this indicates to the driving circuit 110 that a drive motor 112 may be energized to raise or lower the head assembly 104. Preferably, switch 102 would be closed to indicate that the head assembly 104 should be lowered and switch 102 would be opened to indicate that the head assembly 104 should be raised. When switch 102 is closed to indicate that the head assembly 104 should be lowered, driving circuit 110 continuously energizes motor 112 to lower the head assembly 104 until the head assembly 104 trips a touchdown switch 114 indicating that the [head assembly 104 and brush 106 have] nut 69 has reached a repeatable position [such as] defined by a position in which the brush is in contact with the floor 108.

Replace the paragraph beginning at column 9, line 11 with the following:

Once the touchdown switch 114 is tripped, a counter 116 is reset and the driving circuit 110 continues to [lower the head assembly 104 and brush 106] drive the nut 69 down according to a [head] position control 118 set by the operator. Control 118 indicates to the system 100 the additional distance by which the [head assembly 104 and brush 106] nut 69 should be [lowered] driven after the brush 106 comes in contact with the floor 108 and the touchdown switch 114 is tripped. Control 118 may optionally include a display indicating a percentage of the maximum additional distance by which the [head assembly 104] nut 69 should be lowered or a display which indicates the actual distance selected by the operator. A hall sensor 120, associated with the motor 112, monitors the rotations of the motor 112 thereby indicating the position of the [head assembly 104 and the brush 106] nut 69. The hall sensor 120 provides a series of pulses to counter 116 which are converted to an analog position signal by a digital to analog (D/A) converter 122. The analog signal is provided to a comparator 124 and indicates the distance which the [head assembly 104 and brush 106 have] nut 69 has been lowered past the repeatable preset position at which point the touchdown switch 114 was tripped. The [head] position control 118, which may be a potentiometer, generates a desired position signal indicating the desired distance that the [head assembly 104 and brush 106] nut 69 should be lowered beyond the repeatable position. When the analog position signal corresponds to the desired position signal provided by the [head] position control 118, comparator 124 signals driving circuit 110 to discontinue operation of motor 112 because the brush 106 is now in the position relative to the floor 108 to begin treatment.

Replace the paragraph beginning at column 9, line 55 with the following:

The upper portion of the head assembly 105 includes the motor 112 which drives a motor shaft 140 for rotating a plurality of gears 142 which mesh with each other to rotate a screw 144. A [traveling nut] support 146 threadably engaging the screw 144 is raised or lowered by rotation of the screw 144 as caused by the motor 112 rotating its motor shaft 140 to rotate the gears 142. [The nut 146 is covered by] The support 146 includes a nut 146A in threaded engagement with the screw 144, an inner tube 148 which is crimped to and moves with the nut [146] 146A, an end closure 146B closing the lower end of the inner tube 148, and a nut pin 152 extending through the closure 146B (FIG. 6). The inner tube 148 has an upwardly extending portion 150 which extends above the top of the nut to partially cover the screw 144 and to act as a stop. When the [nut] support 146 is in its highest position, portion 150 abuts against a housing 151 for gears 142 and prevents the [nut] support 146 from moving upward.

Replace the paragraph beginning at column 10, line 1 with the following:

The [nut 146] nut pin 152 of the support 146 supports the lower portion of the head assembly 104 by [a traveling nut pin 152 which engages the nut 146 and also engages] engaging an outer slotted tube 154 coaxial with the inner tube 148 and coaxial with screw 144 and nut 146A. The outer slotted tube 154 slides along the inner tube 148 depending on the position of the lower portion of the head assembly 104. Two slots 156 in opposing sides of the outer slotted tube 154 form a guide within which the pin 152 is positioned and moves. As illustrated in FIGS. 5 and 6, the head assembly 104 is in the down position so that the brush 106 is engaging the floor 108. As illustrated in the down position, the [traveling] nut pin 152 is located in the lower portion of the slot 156. The screw 144 has been rotated to move the [nut 150] support 146 downward [thereby causing a downward force on the pin 152] which allows the outer slotted tube 154 and the lower

portion of the head assembly 104 to [drop] move downward to touch the floor 108.

Replace the paragraph beginning at column 10, line 24 with the following:

A compressible member such as a spring 168 is located between the lower end of the [nut] support 146 and the bolt 158. When the head assembly 104 is in its raised position, [traveling] nut pin 152 is held in place at the top of the slots 156 by the [biasing action of the spring 168 between the nut 146 and the bolt 158] weight of the head assembly. As the [nut] support 146 is moved downward by rotation of the screw 144 to lower the head assembly 104, the [traveling] nut pin 152 [continues to be held] stays in place at the top of the slot 156 [by the spring 168]. However, when the brush 106 comes in contact with the surface of floor 108, further downward movement of the lower portion of the head assembly 104 is inhibited. As a result, the continued movement of the [nut] support 146 downward causes the [traveling] nut pin 152 to slide downward in the slots 156 thereby compressing the spring 168.

Replace the paragraph beginning at column 10, line 38 with the following:

A bracket 170 is mounted to the motor 112 by a U-clamp 172 and is supported in a position parallel to the screw 144 and [nut] support 146. The lower portion of the bracket 170 includes a slot 174 which is engaged by two screws 176 which support a switch 178. The switch may be positioned anywhere along the slot 174 so that it may be moved up or down relative to the lower portion of the head assembly 104. The switch 178 has a trip bar 180 which extends toward the outer tube 154 and is positioned immediately above the [traveling] nut pin 152. The [traveling] nut pin 152 has a sleeve or extension 182 (FIG. 6) which engages the underside of the trip bar 180. The position of switch 178 and trip bar 180 define a repeatable position to which the [lower

portion of the head assembly 104] support 146 may be moved. The trip bar 182 is a flexible member which has a fully extended, unflexed position and a flexed position. As shown in phantom in FIG. 5 and referred to by reference character 184, when the lower portion of the head assembly 104 and [traveling] nut pin 152 are in the raised position, trip bar [182] 180 is in the flexed position. As the screw 144 rotates to move the [nut] support 146 downward, nut pin 152 moves downward until it eventually reaches a point at which the trip bar 180 is in an unflexed, fully extended position. This point trips switch 178 and defines the repeatable position of the [head assembly 104] support 146. When switch 178 is positioned within slot 174 so that it is tripped when the brush 106 touches the surface of floor 108, it functions as touchdown switch 114 as illustrated in FIG. 4. As a touchdown switch 114, it defines the repeatable position as the position at which the brush 106 touches the floor 108. [a slot 174 which is engaged by two screws 176 which support a switch 178. The switch may be positioned anywhere along the slot 174 so that it may be moved up or down relative to the lower portion of the head assembly 104. The switch 178 has a trip bar 180 which extends toward the outer tube 154 and is positioned immediately above the traveling nut pin 152. The pin 152 has a sleeve or extension 182 which engages the underside of the trip bar 180. The position of switch 178 and trip bar 180 define a repeatable position to which the lower portion of the head assembly 104 may be moved. The trip bar 180 is a flexible member which has a fully extended, unflexed position and a flexed position. As shown in phantom in FIG. 2 and referred to by reference character 184, when the lower portion of the head assembly 104 and [traveling] nut pin 152 are in the raised position, trip bar 182 is in the flexed position. As the screw 144 rotates to move the nut 146 downward, nut pin 152 moves downward until it eventually reaches a point at which the trip bar 180 is in an unflexed, fully extended position. This point trips switch 178 and defines the repeatable position of the head assembly. When switch 178 is positioned within slot 174 so

that it is tripped when the brush 106 touches the surface of floor 108, it functions as touchdown switch as illustrated in FIG. 1B. As a touchdown switch, it defines the repeatable position as the position at which the brush touches the floor.]

Replace the paragraph beginning at column 11, line 24 with the following:

Assuming that switch 178 is positioned as touchdown switch 114 to indicate when the brush 106 contacts the surface of floor 108, the system 100 would operate as follows and as illustrated in FIGS. 4 and 5. Initially, an operator would set the [head] position control 118 to define a preset distance by which the [head assembly 104] support 146 should be lowered once [it] the head assembly 104 reaches the repeatable position in contact with floor 108. Next, the operator would position the brush up/down switch 102 in the down position indicating to the driving circuit 110 that motor 112 should be operated to rotate screw 144. This causes the [traveling nut] support 146 to move downward relative to the screw 144 and the upper portion 105 of the head assembly 104. As the [nut] support moves downward, [traveling] nut pin 152 also moves downward. When pin 152 reaches a point such that trip bar 180 is in its fully extended position, switch 178 is tripped to indicate that the brush 106 has reached the repeatable position and is in contact with the surface of floor 108. At this point, counter 116 is reset to zero and continued energization of the driving circuit 110 is controlled by the comparator 124. Comparator 124 compares the desired position signal provided by [head] position control 118 to the analog position signal corresponding to the count in counter 116 and indicating the actual position of the [lower portion of the head assembly 104 and brush 106] support 146. The count in counter 106 is generated by a magnet 186 (FIG. 5) positioned on one of the gears 142 which rotates with the screw 144. As a result, the number of pulses or counts generated each time the magnet 186 passes the hall sensor 120 corresponds to the number of rotations of the screw 144 which

in turn corresponds to the position of the [nut] support 146. Additional magnets may be added to the gear to increase the resolution of the system. When the counter 116 includes a count of pulses which corresponds to a rotation of the screw 144 which corresponds to the position of [nut] support 146 which corresponds to the setting of the [head] position control 118, the comparator 124 shuts down the driving circuit 110. Essentially, the additional preset amount that the [nut] support 146 is moved after the repeatable position is approximately equal to the distance or amount by which the spring 168 is compressed. Therefore, this amount is directly proportion to the amount of force that is being applied by the brush 106 to the surface of floor 108.

Replace the paragraph beginning at column 11, line 66 with the following:

As illustrated in FIGS. 5 and 6, the motor 112, gears 142, screw 144, and nut [146] 146A constitute an actuator 39 raising and lowering the head assembly 104 relative to the surface of the floor 108 thereby controlling the relative engagement between the head assembly 104 and the surface 108 and in particular, controlling the relative engagement between the brush 106 and the surface 108. This controls the treatment of the surface by the brush 106. Switch 178 constitutes a sensor for detecting the repeatable position of the [head assembly 104] support 146. The driving circuit 110 is responsive to the switch to lower the [head assembly 104] support 146 an additional preset amount as defined by the [head] position control 118 after the switch 178 detects that the [head assembly 104] support 146 has reached the repeatable position. As a result, the additional preset amount has been defined by input from the operator.

Replace the paragraph beginning at column 12, line 14 with the following:

The [nut] support 146 [constitutes a support which] is a component of the actuator 39 and is raised and lowered by the operation of the actuator 39. The spring 168 becomes a compressible member between the [nut] support 146 [or support] and the lower portion of the head assembly 104. By positioning the switch 178 as shown in FIG. 5 and noted above, it becomes a compression sensor detecting compression of the spring 168 when the support 146 is lowered by the actuator 39. It is also contemplated that other types of compression sensors (or force sensors) may be used to detect compression of the spring 168. It is also contemplated that the switch 178 may be mounted directly on outer tube 154 to detect when the nut pin 152 leaves the up most position within slots 156.

Replace the paragraph beginning at column 12, line 27 with the following:

It should be recognized that the touchdown switch 114 which is implemented in FIGS. 4 and 5 as switch 178 is an optional aspect of the invention to determine the repeatable position. Those skilled in the art will recognize other ways for establishing a repeatable position such as other types of position sensors. In addition, the hall sensor 120 and magnet 186 function as an encoder (detector) to provide a continuous count indicating the position of the [nut] support 146. Therefore, a particular count corresponds to the repeatable position and could be determined by continuously monitoring the count in counter 116. For example, if the driving circuit 110 were a microprocessor based circuit it would be possible to continuously monitor the count of counter 116 knowing that one setting of the count would correspond to a repeatable preset position and another setting for the count would correspond to the additional preset amount defined by the [head] position control 118.

Replace the paragraph beginning at column 12, line 56 with the following:

In another aspect of the invention, it is contemplated that the touchdown switch 114 of FIG. 4 may be used in combination with the embodiment illustrated in FIG. 3. For example, when an operator closes switch 2 to lower the head assembly 4, the driving circuit 10 would energize the motor 12 until the head assembly 4 engages floor 8 and trips the touchdown switch 114. Thereafter, the driving circuit 10 would drive the [head assembly 4] support 146 upward or downward an amount corresponding to the setting of the [head] position control 18. In this embodiment, the control 18 would control the distance of the [head assembly 4] support 146 above or below the point at which the brush 6 engages the floor 8.

Replace the paragraph beginning at column 13, line 1 with the following:

It is also contemplated that the touchdown switch 114 may be a force or position sensor which would sense when the brush 6 contacts the floor. For example, the touchdown switch 114 may be an optical sensor sensing that the brush 6 is in contact with the floor 8, or it may be a proximity sensor, a current (torque) sensor or a force sensor on the head assembly 4 and/or motor 12 which would indicate that the head assembly 4 is in contact with the floor 8. When the head assembly 4 contacts the floor 8, any further downward movement of the [head assembly 4] support 146 will result in an upward force on the head assembly 4 and motor 12, which upward force may be detected by a force sensor on the head assembly 4 or motor 12.

Replace the paragraph beginning at column 13, line 14 with the following:

FIG. 7 is a graph illustrating the relationship between the pressure applied by the brush 106 to the surface of the floor 108, the current or torque driving the brush motor 164 and the position or actuator stroke of the [brush 106] support 146 (FIG.

4) relative to the surface of floor 108. The z axis represents the amount of pressure being applied by the brush 106 to the surface floor 108. There is a point at which the pressure becomes a maximum. Beyond a maximum pressure  $P_{MAX}$ , damage to the brush or to the floor surface or to the brush motor or to another part of the system may occur. Therefore, the maximum pressure  $P_{MAX}$  defines a plane which constrains the operation of the system 100.

Replace the paragraph beginning at column 13, line 34 with the following:

The stroke or distance by which the [brush 106] support 146 is moved is graphed along the y axis. As with pressure and current, there is a maximum stroke  $L_{MAX}$  beyond which damage to the head. The stroke or distance by which the [brush] support 146 is moved is graphed along the y axis. As with pressure and current, there is a maximum stroke  $L_{MAX}$  beyond which damage to the head, system or floor may occur. This maximum stroke  $L_{MAX}$  defines a plane which constrains the operation of the system 100 assembly 104, system 100 or floor 108 may occur. This maximum stroke  $L_{MAX}$  defines a plane which constrains the operation of the system 100.

Replace the paragraph beginning at column 14, line 3 with the following:

The system 200 also includes a memory 222 which is programmed with the maximum information illustrated in FIG. 7. In particular, the memory is programmed with the maximum current, maximum pressure, and maximum stroke. The system 200 also includes operator controls 224 including a torque control 226, a [head] position control 228 and a pressure control 230. The operator is permitted to set these controls anywhere within the acceptable operating region as defined by the rectanguloid R. In particular, the torque control 226 can be set between zero torque and the maximum torque ( $I_{MAX}$ ). The [head] position control 228 can be set by the operator anywhere between the zero stroke point and the maximum stroke point ( $L_{MAX}$ ). Also, the pressure

control 230 may be set anywhere between zero pressure and maximum pressure ( $P_{MAX}$ ). By setting these three controls, the operator defines a point within the rectanguloid R for operation of the system 200.

Replace the paragraph beginning at column 14, line 20 with the following:

In operation, the controller 216 responds to the torque control 226 to provide a torque control signal to the current control 220 thereby controlling the torque and current of the brush motor 214. Similarly, the controller 216 is responsive to the [head] position control 228 for selectively energizing the driving circuit 218 to drive the actuator 212 to maintain a certain position for the brush 208 relative to the floor 210. In addition, the controller 216 is responsive to the pressure control 230 for selectively energizing the driving circuit 218 so that the actuator 212 positions the brush 208 on the floor 210 to maintain constant pressure.

Replace the paragraph beginning at column 14, line 31 with the following:

Although not illustrated in FIG. 8, one of ordinary skill in the art will recognize that the actuator 212 may provide feedback information, such as encoder or position sensor information as noted above with regard to FIGS. 1, 3 and 4 to the controller 216 to indicate the position of the brush 208. In addition, the current control 220 may provide feedback information to the controller 216 to indicate the actual current of the brush motor 214. In another aspect of the invention, it is contemplated that any one of the three controls may be designated as a dominant control and that the other two controls may be designated as limit controls. For example, if torque control 226 is of primary interest, the torque control 226 would be set by the operator to indicate the desired torque. The [head] position control 228 would be set by the operator to indicate the maximum stroke and